

VEHICLE TRACKING

by George DuBois

How The Fleet Operators Keep Track Of Their Trucks

Vehicle tracking has become a big business, with the largest customers trucking companies. The advantages are obvious: the ability to instantly know the exact location of the closest vehicle to a customer; the ability to reroute the closest truck to pick up a new load and minimize delays; and even the capability to monitor vehicle performance - which all translate into increased profits in an extremely competitive business.

Qualcomm was mentioned briefly in our article on the demise of Motorola's CoveragePlus vehicle tracking system. CoveragePlus used a network of trunked 800 MHz repeaters around the country to provide locating and messaging service to vehicles. It just couldn't compete in an increasingly-crowded marketplace, and therefore Motorola pulled the plug on it. All inquiries about the service are now being referred to Qualcomm. So just who or what is Qualcomm?

Qualcomm is a manufacturer of a wide range of communications equipment and services. Their products range from military data link systems to encoder I.C.'s to equipment for the new Low Earth Orbit Mobile Satellite Service. In the vehicle-tracking market, they are a single-source supplier of hardware and software packages, as well as satellite-based communications service. Qualcomm was founded in 1985. Their headquarters are in San Diego, California.

They are not alone in this market. There are a number of competing systems, including a similar service offered by Rockwell International which uses Global Positioning System combined with their ProSeries satellite communications package. The Rockwell system is currently leasing satellite capacity from American Mobile Satellite Corp. (AMSC) which, in turn, is preparing to launch their own satellite this year. AMSC also offers a two-way messaging and GPS locating service, using leased satellite capacity.

At least a couple of other systems are using the cellular telephone network to transmit location information and data messages, via the packet-cellular service offered by some cellular providers. Voice service is obviously also available with these services. And Orbcomm, one of the licensees for the new 137 MHz Low Earth Orbit satellite service, recently announced that they will provide satellite tracking service, through Racotek, Inc., on their system.

But Qualcomm was the first. They introduced their OmniTRACS system in the late 1980's. They advertise their system as "the most technologically advanced two-way mobile satellite communications and tracking system of its kind in the world." The system provides data transmission and position-reporting services to over 325 transportation companies and other mobile customers. They claim to have sold over 82,000 OmniTRACS terminals worldwide. Location information and messages are sent via satellite to their Net-

work Management Center, then to subscriber's dispatch offices throughout the U.S.

Instead of using one of the new Mobile Satellite Services, however, Qualcomm provides two-way data communications between their customer's operations center and their mobile units by using capacity on 12/14 GHz domestic-fixed satellites.

Qualcomm's network initially used two transponders on GTE Spacenet Corporation's GSTAR 1 satellite - one for the link from the hub station to the satellite to the user terminal (forward link) and one for the link from the user terminal to the satellite to the hub station (return link). Qualcomm has contracted with GTE for satellite service through the year 2003. (GTE Spacenet was acquired last fall by GE American Communications.)

In order to provide mobile, vehicle-tracking service in the 12/14 GHz band, Qualcomm had to petition the FCC for a waiver to use these bands, which are allocated to the Fixed-Satellite Service - video services, fixed data transmissions, and the like.

Qualcomm was granted a waiver because their system is very similar to those currently permitted under the FCC's rules for VSAT terminals - Very Small Aperture earth stations used for up- and down-links. Large, nationwide corporations license and install these terminals at their various locations throughout the country, using them to relay accounting and billing information, inventory data, even the transmission of video teleconferences, training sessions and so forth. You see these terminals everywhere, from Walgreens to gas stations. Qualcomm pointed out that their OmniTRACS system would be very similar to these VSAT terminals, except that they would be mobile!

In January of 1989, Qualcomm was granted authority to construct and operate up to 20,600 Very Small Aperture 12/14 GHz mobile and transportable transmit/receive earth stations and to operate a fixed 12/14 GHz transmit/receive earth station to serve as the hub station for the network. The Earth-to-space transmission link is in the 14.0 to 14.5 GHz frequency band, which is allocated both domestically and internationally to the Land Mobile Satellite Service on a secondary basis. The space-to-Earth transmission link is in the 11.7 to 12.2 GHz frequency band. Both bands are allocated to the Fixed-satellite service on a primary basis.

Qualcomm observed that because its system will use capacity on operational satellites, it would be able to bring the benefits of two-way, satellite-based mobile communications services, including ancillary position-location information, to the public immediately. They stated that the service would be attractive to those customers having a need for specialized two-way data communications services, such as

long-haul trucking companies, industries which provide services in the field, public safety organizations, and transportable earth station users with low data-rate requirements or who face antenna size restrictions.

The first Qualcomm units placed in service used frequency-hopping spread-spectrum emissions spread over the entire transponder bandwidth. Later units use a power-dispersal technique over 2 MHz of the transponder. One condition of Qualcomm's use of Fixed-satellite transponders was that their signal not exceed a certain power level at the earth's surface. For the most part, their signal has an interference potential equivalent to a typical television video signal carried on a satellite transponder. The greatest interference threat would be to Single Channel Per Carrier (SCPC) and other low-capacity satellite users. But this can easily be accommodated technically, such as the requirement that wider-bandwidth signals use the center portion of each satellite transponder.

To prevent interference on the satellite uplink frequency, Qualcomm is also required to limit the number of mobile units transmitting at any given time so that the total power received at the satellite is the same as what would be received from a typical fixed earth station. Individual mobile units must only transmit data messages upon command from the control

hub on the satellite downlink.

Operation is pretty straight forward. Outbound messages from customers' operations centers are carried via leased or dial-up telephone lines or satellite circuits to Qualcomms Network Management Center. These messages are transmitted by the hub station to the satellite. The satellite then retransmits these messages to individual mobile or transportable user terminals. Each message packet has a unique address so that it is intelligible only to the terminals authorized to receive it. The user terminals, in turn, transmit messages to the satellite whenever direct line-of-sight to the satellite is possible. These messages are retransmitted by the satellite to the hub station for distribution to customers' operations centers. The operators or drivers can send predetermined "canned" messages, fill-in-the-blank forms or text messages.

The Hardware

The OmniTRACS system is made up of three components. These are the mobile communications equipment, the network management service and the system software.

The mobile communications equipment consists of the radio transceiver, the dome-shaped tracking antenna and the cab-mounted keyboard and dis-

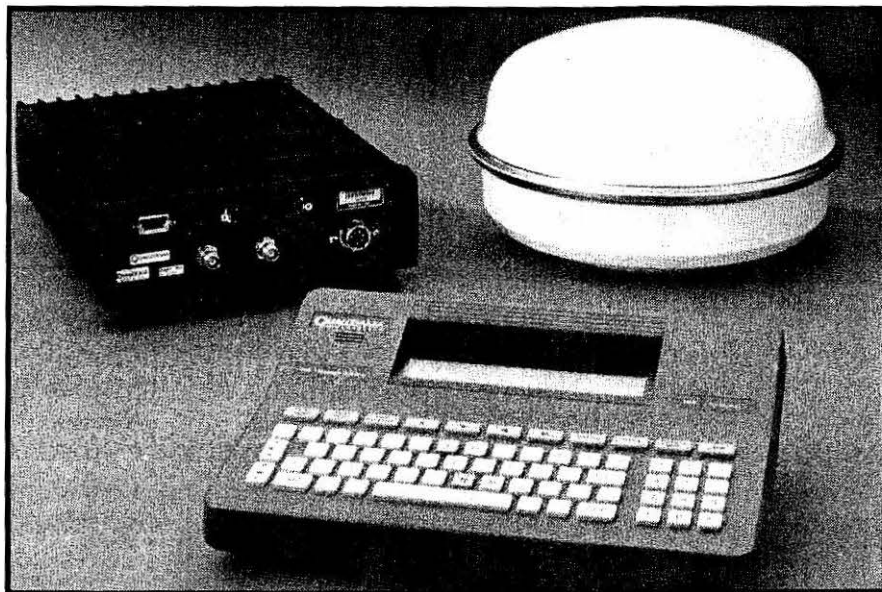
play unit.

The communications unit provides the capability to send and receive digital messages to and from the vehicle. It uses an Intel microprocessor for its own computing power. The antenna is a Ku-band antenna designed exclusively for the OmniTRACS system. It uses an electronically driven motor to continuously aim the antenna toward the satellite. The keyboard unit contains a full keyboard with a numeric keypad and is capable of sending and receiving text messages of up to 1900 characters. The display is a four-line, backlit Liquid Crystal Display (LCD). Vehicle locating service on Qualcomm's system is provided in one of two ways. The first is Qualcomm's innovative system that uses the communications satellites to provide signal triangulation. It is accurate to within 1/4 of a mile. The other uses a separate Global Positioning System (GPS) receiver to derive highly accurate location information, to within 1000 feet. This is then transmitted on the system to the users dispatcher.

The Network Management Center is the hub of the OmniTRACS system. It is manned 24 hours a day. Duplicate computer systems provide redundancy, along with a backup generator in case of a power failure. In the extreme case of an earthquake or other natural disaster, Qualcomm also maintains a fully equipped, duplicate hub in Las Vegas, Nevada.

Communications with subscriber's dispatch centers is via dedicated leased telephone lines, time-share packet networks or dial-up telephone services.

Completing the package is the systems software, used by the subscribers at their dispatch offices and in vehicle terminals. Qualcomm has devoted considerable research and marketing effort into their various software packages. Their Qualcomm Decision Support System (QDSS), for example, is a family of software products aimed



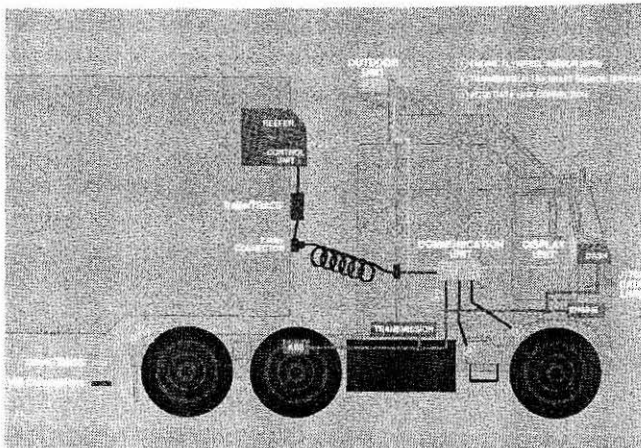
at trucking concerns. The system provides real-time position information, communications capability and route planning to optimize power-to-load matching to better optimize freight selection and capacity utilization. The software is designed to take into account equipment requirements, driver hours, delivery schedules and customer priority.

Qualcomm also offers a number of custom hardware packages, a family of integrated monitoring products. Their SensorTRACS system monitors speed and rpm and generates a driver performance report. Unlike a conventional trip recorder, however, the system can generate a report in real time, and download it via the satellite system.

The JTRACS system connects to the data bus found in most modern trucks and can be set up to monitor any desired parameters, relaying fault codes to the operators maintenance personnel. A needed part can be waiting at the maintenance facility in the next town. Routine information can be stored and downloaded later.

TrailerTRACS can monitor electronically controlled refrigeration units, continuously displaying critical parameters to the driver. The same information can be requested by the dispatcher on demand, transmitted via the tractor communications unit.

Qualcomm's service charges are based on the number and character length of messages handled, plus a monthly service fee for each vehicle. The service fee includes hourly position reports. More frequent position reports are charged at the normal message rate.



Qualcomm's OmniTRACS Vehicle Information System (VIS) is a family of integrated vehicle monitoring products. Some of the sensors that Qualcomm's JTRACS diagnostic reporting system can monitor include: Vehicle Speed, Engine Speed, Boost Pressure, Oil Pressure, Oil Temperature, Coolant Temperature, Intake Air Temperature, Ambient Air Pressure, Engine Brake Relay, Fan Clutch Solenoid, Fuel Shutoff Solenoid, Fuel Injector Solenoid. Qualcomm also markets a complete line of "QTRACS" software.

The Future

Fleet Owner magazine reported last Fall that Qualcomm is also considering constructing a land-based system to supplement its satellite-based system. This hybrid system would provide satellite coverage in rural areas and low-cost, high-volume data service via land mobile systems in urban areas.

More recent reports indicate that the land-based service would be leased service on either the Ardis or RAM Mobile Data nationwide 800 or 900 MHz data communications systems.

Qualcomm was beat to the punch in this area. Rockwell is advertising the fact that their ProSeries service offers "Multi-Mode Communications, with GPS." If a vehicle is in an urban area served by the ARDIS network, the mobile system automatically selects that mode of operation, providing lower message costs and in-building coverage. In rural areas, data is transmitted on their 1.6 GHz satellite links.

Qualcomm recently announced that they had installed their 100,000th satellite transceiver. Two recent, 1000-unit contracts pushed them over this milestone. One of these was from Tyson Foods. According to Qualcomm, they now have more mobile terminals in service than all other providers combined.

In other fields, Qualcomm has also been instrumental in the commercial development of CDMA (Code Division Multiple Access) technology, which they describe as the next-generation technology for digital, wireless communications. They note that it increases channel capacity by as much as ten-to-twenty times over today's analog FM systems while, (they claim) improving audio quality. CDMA uses spread-spectrum technology to break up speech into small, digitized segments and encode them to identify each transmission. A large number of users can thus share the same band of frequencies, increasing system capacity.

As a matter of fact, the recently-adopted industry standard for CDMA, IS-95, was based largely on Qualcomm's design. This is the standard that looks likely to be the one that will be adopted by a majority of cellular operators nationwide.

Qualcomm also is involved in a joint venture with Loral Aerospace Corporation to develop and implement one of the new 1600 MHz Low Earth Orbit (LEO) satellite systems, under the trade name Globalstar. In January, they were granted one of the first licenses in the new, so-called "Big LEO" service.

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